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Eliciting the Level of Health Inequality Aversion in England

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CHE Research Paper 125

Eliciting the level of health inequality aversion in England

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Background to series

CHE Discussion Papers (DPs) began publication in 1983 as a means of making current research material more widely available to health economists and other potential users. So as to speed up the dissemination process, papers were originally published by CHE and distributed by post to a worldwide readership.

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We obtained research ethics approval from the University of York Health Sciences Research Governance Committee, in a letter dated 23 May 2013. The main ethical issues involved informed consent and data security to ensure participant responses were kept anonymous and no personal data disclosed.

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Abstract

Policy makers faced with equality-efficiency trade-offs can articulate the nature and extent of their health inequality aversion using social welfare functions. In this study we use data from an online survey of the general public in England (n=246) to elicit health inequality aversion parameters by numerically solving Atkinson and Kolm social welfare functions. We elicit median inequality aversion parameters of 10.95 for Atkinson and 0.15 for Kolm. These values suggest substantial concern for health inequality among the English general public which, at current levels of quality adjusted life expectancy, implies weighting health gains to the poorest fifth of people in society six to seven times as highly as health gains to the richest fifth.

Key words: health inequality; inequality aversion; social preferences; survey; welfare function;

1. Introduction

Health policy has two main objectives, improving health and reducing health inequality. When these two objectives conflict, Health-Related Social Welfare Functions (HRSWFs) can be used to articulate the trade-off between them. Economists have explored the properties of several SWFs which aim to capture these trade-offs in the form of a single inequality aversion parameter. The Atkinson Index (Atkinson, 1970) and Kolm Index (Kolm, 1976) are two such forms, concerned with relative and absolute concepts of inequality widely used in the income inequalities literature. A range of two person HRSWFs have also been proposed (Wagstaff, 1991, Abásolo and Tsuchiya, 2004), and there have been various attempts to elicit health inequality aversion parameters for some of these functions from interview data of members of the public in England (Dolan and Tsuchiya, 2011, Edlin et al., 2012) and Spain (Abásolo and Tsuchiya, 2013).

Building on the questionnaire instrument employed in these existing studies, we have previously conducted methodological work to develop and validate a video animation designed to encourage respondents to think carefully about their responses (Cookson et al., 2015). The contribution of this paper is to elicit inequality aversion parameters for the Atkinson and Kolm SWFs using online survey data from the general population in England that incorporates this video animation. These parameter values can help to inform health policy makers in England who wish to explicitly incorporate social value judgements concerning health inequalities into decisions regarding the allocation of health care resources.

2. Methods

2.1 Survey

Details of the survey methods are reported in Appendix A and the sample characteristics in Appendix B. An online survey was used to obtain a sample of 462 respondents from the English general population, of which 246 provided usable data. Respondents were presented with information highlighting inequalities in expected years of life in full health at birth between the richest and poorest fifths of people in England. Respondents made a series of seven pairwise choices between two programmes which would increase expected years in full health. In each choice, Programme A favoured the richest fifth, and Programme B the poorest fifth. In the first choice, Programme A provided an increase of seven years to the rich and three years to the poor, and Programme B provided an increase of three years to the rich and eight years to the poor. In each successive choice, the years gained by the poor group in Programme B were gradually reduced, while everything else was fixed. In each choice the respondents were asked to decide whether the government should choose Programme A, Programme B or whether the two programmes were equally good.

2.2 Categorisation

To elicit the inequality aversion parameters we developed a response classification system, which is shown in Appendix C. The point at which the respondent 'switches', or becomes indifferent, between the programmes was used to categorise respondents and derive the level of inequality aversion. Those categorised as 'Pro-Rich' prefer health gains to the better-off; 'Health Maximisers' are concerned only with increasing total health; 'Weighted Prioritarians' give greater weight to the health of the worse-off; 'Maximin' respondents are concerned only with improving the health of the worst-off; and 'Egalitarians' value reducing health inequality so much that they are willing to sacrifice potential health benefits to the worst-off.

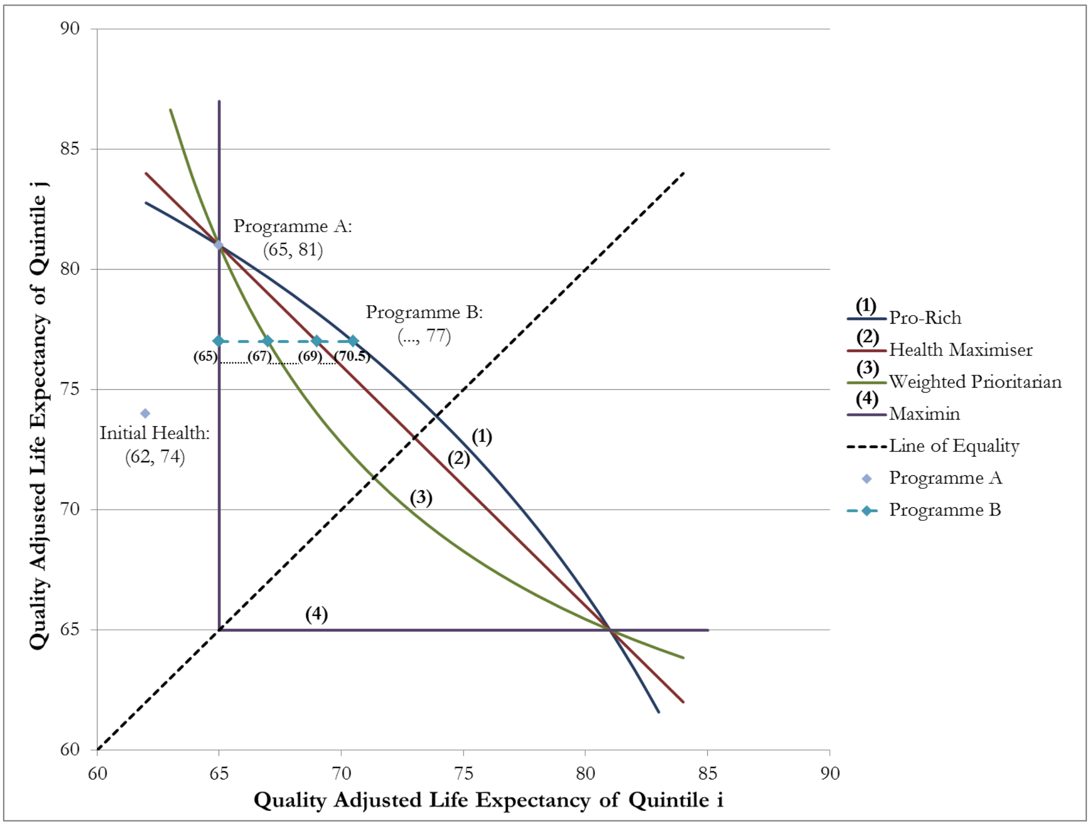

Figure 1: Iso-welfare curves representing response categories

Figure 1 illustrates a range of iso-welfare curves for the Atkinson Index, plotted at different levels of inequality aversion corresponding to four selected responses. The horizontal and vertical axes represent the quality-adjusted life expectancy of the poorest and the richest fifths, respectively. Point (62,74) is the initial distribution of health, while point (65,81) represents programme A, which remains fixed through the seven choices. The dashed line from (65,77) to (70.5,77) gives the range of values from Programme B.

2.3 Social welfare functions and equally distributed equivalents

The Equally Distributed Equivalent (EDE) level of health builds on the concept of EDE income, defined as the mean level ‘which if equally distributed would give the same level of social welfare as the present distribution’ (Atkinson, 1970). It provides an index of social welfare standardised to the mean level of health which enables the comparison of different health distributions. The equations for the EDEs used in this paper are:

$$EDE(Atkinson) = \overline{H}.\left[\sum_i \left(\frac{H_i}{\overline{H}}\right)^{1-\varepsilon} f(x_i)\right]^{1/(1-\varepsilon)} \quad (1)$$

$$EDE(Kolm) = \overline{H} - \left[\left(\frac{1}{\alpha}\right) log \sum e^{\alpha.(\overline{H}-H_i)} f(x_i)\right] \quad (2)$$

In these equations, ε and α are the inequality aversion parameters for the Atkinson and Kolm HRSWFs respectively. H_i is the level of health (quality-adjusted life expectancy) for subgroup *i*, $\overline{H}$ is the mean level of health for the entire population and $f(x_i)$ the proportion of the population in subgroup *i*. Unlike most previous studies, our data allow the elicitation of negative parameters for individual respondents representing ‘inequality seeking’ judgements, as well as positive parameters representing ‘inequality averse’ ethical judgements.

2.4 Parameter elicitation

The point where a given respondent switches from one programme to the other, or selects ‘equally good’, is interpreted to reflect the point at which the respondent is indifferent between the two programmes. The implied inequality aversion parameter for each respondent can then be established by numerically solving the EDE equations.

2.5 Establishing a population average

In order to represent inequality aversion parameter for the population, we use the median response rather than the mean. This is because the inequality aversion parameter approaches infinity for ‘Maximin’ responses (Dolan and Tsuchiya, 2011). To make the analysis sample as representative as possible, population weights for England for age, gender, income and education were derived from Understanding Society Wave 4 (Essex., 2015), and used to weight sample responses to construct a response set representative of the general population. Further details of this weighting can be found in Appendix B. To allow for uncertainty, we estimate 95% confidence intervals for each parameter using a non-parametric bootstrap of the survey data, resampling from the population weighted raw data 2,000 times.

2.6 Sensitivity analyses

Our classification scheme focused on 'logical’ response patterns in which only one ‘switch’ is observed or one programme is selected throughout, and the results reported below include the 246 responses that provided selections that were consistent with the classification. We conducted sensitivity analyses using more permissive inclusion criteria, including 285 and 317 responses respectively, as explained in Appendix D.

3. Results

Figure 2 illustrates the distribution of responses for each category, after sample re-weighting. Just over half, 50.98%, of the responses were 'Weighted Prioritarian', but there were substantial responses in the tails of the distribution with 15.58% being 'Pro-Rich' and 27.28% being 'Egalitarian'. The vast majority of respondents, 81.52%, were willing to trade-off some total health in order to reduce health inequality and only 2.91% were strict 'Health Maximisers'. The parameters for each categorical response, for each SWF, can be found in Appendix E.

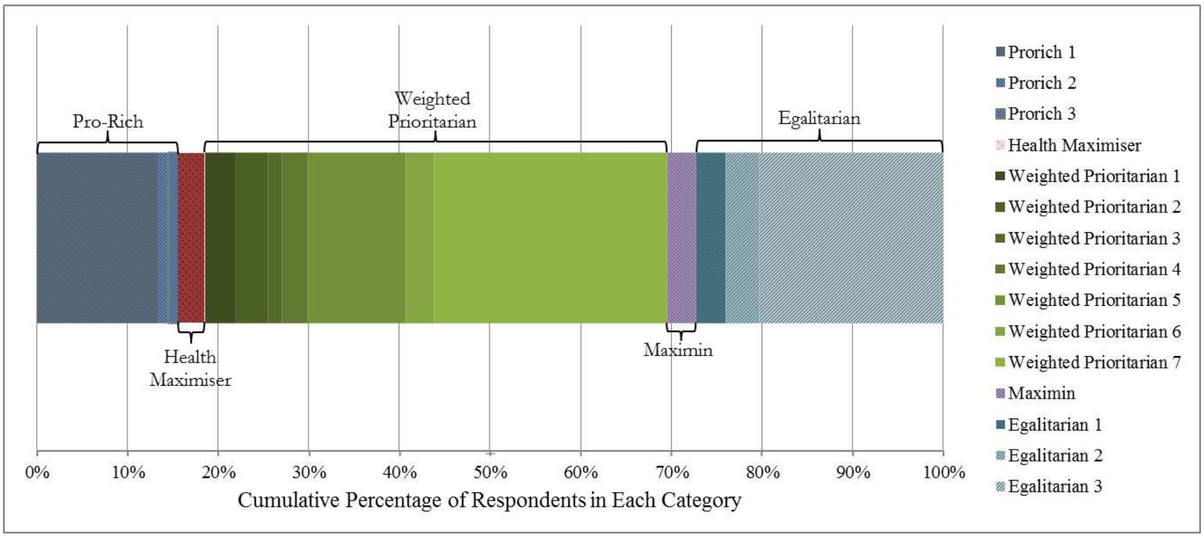

Figure 2: Weighted distribution of categorical responses (n=246)

The elicited inequality aversion parameters, and the EDE level of health they imply, are given in Table 1. The results mean that, at initial levels of quality-adjusted life expectancy, incremental health gains to the poorest fifth of people in society should be weighted between 6 and 7 times as highly as incremental health gains to the richest fifth. Sample weighted bootstrapping revealed that the 95% confidence intervals did not exceed the category in which the median response was.

Table 1: Base Case Inequality Aversion Parameters with 95% Confidence Intervals

SWF	**Median*** (95% CI)	**Implied weight**** (95% CI)
Atkinson (ε)	**10.95** (10.95 – 10.95)	**6.95** (6.95 - 6.95)
Kolm (α)	**0.15** (0.15 – 0.15)	**6.20** (6.20 – 6.20)

Footnotes to the table
* Median preference identified through bootstrapping; population weights used
** Implied weight of marginal health gain to poorest fifth of the population compared to the marginal health gain to the richest fifth of the population at initial health

The median inequality aversion parameters were robust and were not affected by the sensitivity analyses using larger samples (see Appendix D for details).

4. Discussion

4.1 Comparison to previous literature

There have been a number of previous empirical studies of health inequality aversion using the same basic questionnaire instrument in England (Williams et al., 2005, Dolan and Tsuchiya, 2007, Dolan and Tsuchiya, 2009, Dolan and Tsuchiya, 2011) and Spain (Abásolo and Tsuchiya, 2004, Abásolo and Tsuchiya, 2008, Abásolo and Tsuchiya, 2013). All of these studies have found that the majority of the population is willing to sacrifice a substantial amount of total health in society in order to reduce health inequality, as have most studies using different instruments (Edlin et al., 2012, Attema et al., 2015). In most cases it is not possible to extract comparable inequality aversion parameter central estimates, because parameters were not reported or are not comparable. However, Dolan and Tsuchiya (2011) report an equivalent Atkinson **ε** value of 28.9, which is considerably larger than our value of 10.95. One reason for the difference may be that their study did not use our animated video e-learning intervention which tends to reduce the proportion of respondents expressing extreme inequality aversion; another may be that their study used face-to-face rather than online administration; a third may be that their study used half-year response categories which allow more extreme inequality aversion to be expressed. Two of the studies in Spain, Abásolo and Tsuchiya (2004) and Abásolo and Tsuchiya (2013), find such extreme inequality aversion that the Atkinson ε value is not identified as the median response violated monotonicity – i.e. programme B was selected all the way.

4.2 Application to distributional cost-effectiveness analysis

To illustrate how this value could be used in practice, we present an example below from a distributional cost-effectiveness study of two different ways of spending the same fixed budget for increasing uptake of a pre-existing universal bowel cancer screening programme (Asaria et al., 2015). Assuming no inequality aversion, it is more cost-effective to spend the budget on a ‘Universal’ reminder programme rather than the ‘Targeted’ reminder that reduces health inequality by targeting the most income deprived. As Figure 4 of their paper illustrates, distributional cost-effectiveness analysis identifies the threshold level of inequality aversion above which the ‘Targeted’ reminder becomes cost effective ($\varepsilon = 8$ and $\alpha = 0.12$). Thus the corresponding parameter values generated in our study ($\varepsilon = 10.95$ and $\alpha = 0.15$) suggest that the targeted intervention is cost effective after allowing for inequality aversion. Table 2 illustrates, by computing EDE QALYs per 100,000 for different levels of inequality aversion.

Table 2: QALY and EDE QALY gains per 100,000 population

	Programme	
	Targeted	**Universal**
Gains in average QALYs ($\varepsilon = \alpha = 0$)	3850	**4000**
Gains in Atkinson EDE QALYs ($\varepsilon = 10.95$)	**3310**	3260
Gains in Kolm EDE QALYs ($\alpha = 0.15$)	**3300**	3270

5. Conclusion

Atkinson's and Kolm's inequality aversion parameters were elicited using an online survey of members of the general public in England. The vast majority of people who gave useable responses, 81.52%, were willing to sacrifice gains in total health in order to reduce health inequality. The responses indicate substantial aversion to health inequality among the English general public, in line with findings from previous studies. If these responses are taken at face value, they imply that marginal health gains to the poorest fifth should be given between 6 and 7 times the weight of health gains to the richest fifth. The inequality aversion parameters elicited provide values which can be used within methods such as distributional cost-effectiveness analysis. Through using these methods societal decision makers can evaluate health policies which have the dual objectives of improving population health and reducing health inequality.

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Appendices

Appendix A: Survey methods

Survey administration and recruitment were performed by a commercial online survey company, called 'SmartSurvey' (https://www.smartsurvey.co.uk). This survey company has a large pre-existing consumer panel of individuals throughout the UK who complete online surveys sponsored by a variety of public, private and academic research organisations. Unfortunately, however, the survey company were unable to provide us with response rate information either about selection into the panel from the general public, or about selection into our survey from their panel. The research team designed and created the online questionnaire within web-based software provided by SmartSurvey. Respondents completed the survey from personal computers over the internet. Prior to answering the trade-off questions respondents were shown an e-learning video, designed and piloted by the research team (Cookson et al., 2015). This video was intended to increase understanding of the trade-offs they were to make and can be accessed at the following link: https://vimeo.com/91930211. After this, each respondent answered additional questions on demographics and social attitudes.

Screenshots of the seven pairwise choices are below; and screenshots of the full online survey are available at: www.york.ac.uk/che/research/equity/economic_evaluation/publicviews/

TRADE OFF QUESTION

Imagine that you are asked to choose between two large government programmes which will improve population health. Both programmes cost exactly the same.

Who Benefits?

Programme	Population Group	Before	Change	After
Programme A	Richest Fifth	74	+7	81
	Poorest Fifth	62	+3	65
Programme B	Richest Fifth	74	+3	77
	Poorest Fifth	62	+8	70

These are gains in years of life in full health over the average person's lifetime.

When making a decision, it is important to remember the following:

- We cannot pay for both programmes - a choice must be made
- "Equally good" means you don't mind which one is chosen
- Both programmes cost exactly the same
- The only difference between the programmes is the gain to the poorest and richest fifth
- The middle three fifths of the population are not affected

Which programme should the government choose?

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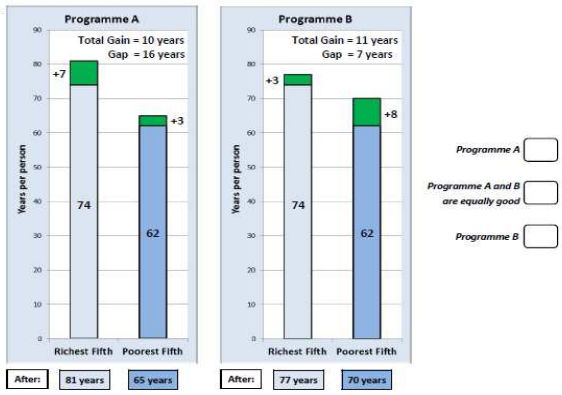

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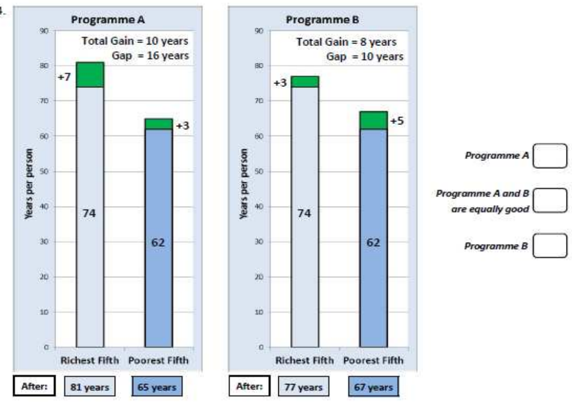

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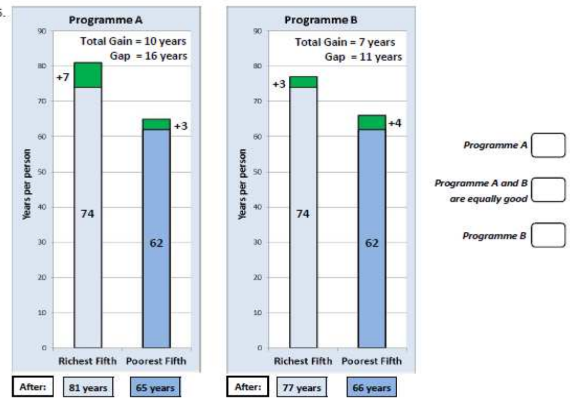

Now imagine it is more difficult than we thought to benefit the poorest fifth.
For each of the following comparisons please tick ONE box per comparison.

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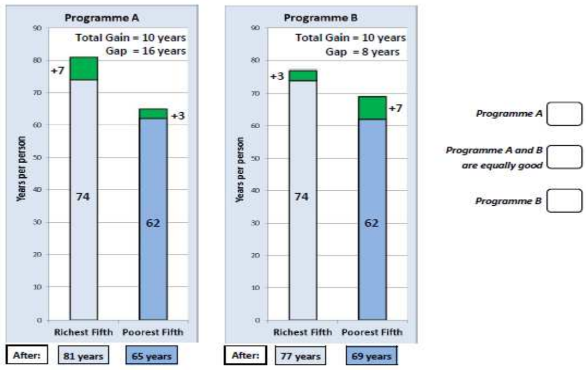

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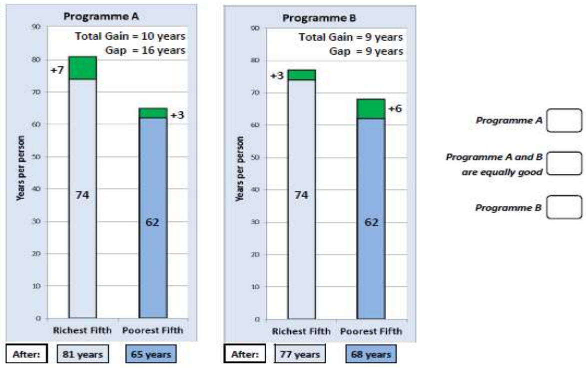

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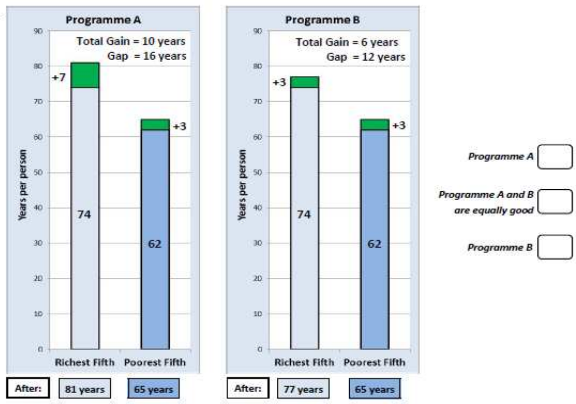

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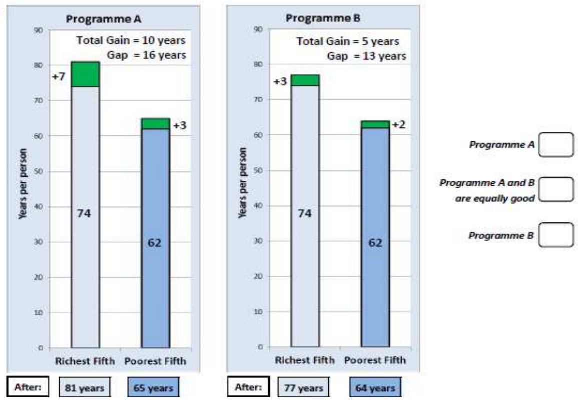

Figure A1: Online trade-off questions

Appendix B: Sample characteristics compared with the English population

This table shows basic descriptive statistics of the sample compared with the English general population. Data for the general population in England are taken from Understanding Society 2014 (Essex., 2015), a large and representative household sample survey.

Table A1: Comparable sample compositions: general English population and survey sample (n=246)

Highest qualification	Population in England	Sample
Degree	24.60%	52.85%
Other Higher Degree	11.52%	7.72%
A Level etc	20.22%	13.01%
GCSE etc	19.96%	17.48%
Other Qualification	10.41%	4.88%
No Qualification	13.29%	4.07%

Sex	Population in England	Sample
Male	48.29%	48.78%
Female	51.71%	51.22%

Age group	Population in England	Sample
18-34	25.69%	29.67%
35-49	26.20%	22.76%
50-64	24.62%	34.15%
65+	23.84%	13.41%

Household income before tax	Population in England	Sample
£1000 or Less	7.23%	28.46%
£1001 - 1700	15.02%	19.11%
£1701 - 2700	20.73%	14.63%
£2701 - 4200	24.51%	13.41%
£4201 or more	32.51%	24.39%

In order to readjust the sample to ensure representativeness weights were generated for each of the four dimensions, resulting in 240 independent weights from our sample and the Understanding Society sample. The Stata command *bsweights* (Kolenikov, 2010) was used to implement a *svy bootstrap*, which executed a bootstrap, for complex survey data. This method allowed the calculation of the 95% confidence intervals for the sample, weighted to reflect a representative sample.

Appendix C: Response Categorisation

Responses are denoted by seven-character sequences representing the seven sequential choices in the questionnaire. A response denoted by 'A' shows a preference for Programme A, 'B' for Programme B and '=' for an indifference between the two. BBBB=AA, for instance, indicates that the respondent preferred Programme B in the first four choices, was indifferent in the fifth and preferred Programme A in the final two choices.

Table A2: Categorisation of responses

Rank	Category	Response	Indifferent between	
			Health gains programme A	Health gains programme B
1	Pro-Rich 1	AAAAAAA	7, 3	3, 8.5
2	Pro-Rich 2	=AAAAAA	7, 3	3, 8
3	Pro-Rich 3	BAAAAAA	7, 3	3, 7.5
4	Health Maximiser	B=AAAAA	7, 3	3, 7
5	Weighted Prioritarian 1	BBAAAAA	7, 3	3, 6.5
6	Weighted Prioritarian 2	BB=AAAA	7, 3	3, 6
7	Weighted Prioritarian 3	BBBAAAA	7, 3	3, 5.5
8	Weighted Prioritarian 4	BBB=AAA	7, 3	3, 5
9	Weighted Prioritarian 5	BBBBAAA	7, 3	3, 4.5
10	Weighted Prioritarian 6	BBBB=AA	7, 3	3, 4
11	Weighted Prioritarian 7	BBBBBAA	7, 3	3, 3.5
12	Maximin	BBBBB=A	7, 3	3, 3
13	Egalitarian 1	BBBBBBA	7, 3	3, 2.5
14	Egalitarian 2	BBBBBB=	7, 3	3, 2
15	Egalitarian 3	BBBBBBB	7, 3	3, 1.5

The table shows each of the 15 'logical' responses; where respondents prefer either Programme A or B throughout, or have a single 'switching' point. In the cases where respondents 'switched' directly between the two programmes, rather than explicitly specifying that they considered the two programmes to be equal, the health gains at the switching point were assumed to be halfway between the two scenarios on either side of the switch. The point of indifference could not be observed for the Pro-Rich 1 and Egalitarian 3 responses; for these respondents it was assumed that they would have 'switched' at the next logical scenario i.e. where the health of the poorest group under Programme B was increased or decreased by another half a year respectively.

Appendix D: data quality sensitivity analysis

There were 462 respondents who partook in the survey. We excluded 58 'unusable' responses, where respondents either (a) answered the questions in less than the five minutes it takes to watch the video and/or (b) answered 'equally good' to every question. Of the useable sample of 404 respondents, there were 158 (39%) which did not fall into our theoretical categorisation, leaving 246 for the base case analysis. The first sensitivity analysis included responses that suggest a degree of imprecision, where respondents responded 'equally good' in two or more consecutive pairs, and this resulted in including an additional 39 responses. The second sensitivity analysis included responses that suggest a degree of instability, whereby two B-to-A switching points were observed suggesting a possible one-off error that is subsequently corrected (e.g. BBABAAA). In this case, we randomised which switching point to accept as the correct one, which resulted in including a further 71 responses. The median rank did not change in any of these sensitivity analyses, and therefore our value for the inequality aversion parameters, based on this median rank, is robust to these alternative data quality inclusion criteria.

Table A3: Data quality sensitivity analysis, sample sizes and median categorical rank

Sensitivity analysis	Useable responses (N = 404)				Median rank
	'Consistent'		'Inconsistent'		
Base case	**246**	60.89%	**158**	39.11%	11
First	**285**	70.54%	**119**	29.46%	11
Second	**317**	78.47%	**87**	21.53%	11

Appendix E: Categorised Inequality Aversion Parameters

The specific inequality aversion parameters associated with each response category are given for each of the SWFs in the table below. By inputting the parameters below into each SWF the level of social welfare for specific distributions can be shown for precise levels of inequality aversion.

Table A4: Inequality aversion parameters for each response category

Rank	Category	Atkinson's, ε	Kolm's, α
1	Pro-Rich 1	-2.075	-0.028
2	Pro-Rich 2	-1.419	-0.019
3	Pro-Rich 3	-0.731	-0.01
4	Health Maximiser	0	0
5	Weighted Prioritarian 1	0.792	0.011
6	Weighted Prioritarian 2	1.671	0.023
7	Weighted Prioritarian 3	2.673	0.037
8	Weighted Prioritarian 4	3.862	0.053
9	Weighted Prioritarian 5	5.358	0.074
10	Weighted Prioritarian 6	7.43	0.103
11	Weighted Prioritarian 7	10.946	0.152
12	Maximin	∞	∞
13	Egalitarian 1	NA	NA
14	Egalitarian 2	NA	NA
15	Egalitarian 3	NA	NA